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WEB APPLICATION DEVELOPMENT FOR THE FINNISH DEFENCE FORCES (LIIKKURI)

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Le Tieu Phi
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ABSTRACT

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The development of information technology and the handheld devices help people easily to handle everything most efficiently. The amount of hand records or notebooks will be replaced step by step by basic office tools such as Word, Excel. Recently, web applications and mobile platform applications are becoming more popular, the administrative procedures and millions of rows of record are extracted and processed just within a few seconds.

The Finnish Defence Forces, which receives hundreds of military applications every year, recognized the importance of applying technology in management and processing of data, therefore they invested in creating a web-based application without a responsive design 10 years ago.

The main purpose of this Bachelor's thesis was to recount the studies and knowledge which were used in the process for designing a new web application based on Laravel Framework to manage the number of applicants registered in annual obligations and to update sports activities in garrisons. This website is a completely new version with a fast performance, new features, a responsive design and an eye-catching interface. The result is outstanding, the customers are totally satisfied and it is also a good portfolio for the Finternet Group company to promote their business.

Keywords: Laravel, web management system, mobile platform, responsive design, army

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1 INTRODUCTION

The Finnish Defence Forces created a website to manage and introduce the training activities for young men who were going to participate in military as their obligation for 10 years ago. The website was out of date and it was not able to up-to-date it anymore because the coder of the website left the project. The military management is very complicated to handle because of the number of new conscripts every year, and there are not enough human resources to do paperwork and to update notifications every day or week to each individual or garrison. The lack of employees caused inefficiency at work. That was the reason why they ordered the company to build an application which works on a desktop and a mobile platform.

This study focuses on the process of building the web application with a responsive design using Laravel Framework 5.3, VueJs 1.0, jQuery 3.1.1 and some other plugins. This process was done by the author of the thesis in cooperation with Finternet Group Company's programming developers.

After discussing with officers of Finnish Defence Forces in the Helsinki Garrison, the CTO of the company decided to open the project with the name Liikkuri to handle the process of building the web application. The company is responsible for the construction of database system, User Interface, system user multi levels, authentication, authorization, CRUD for sports activities, check in/checkout systems for conscripts when they participate in activities, points system after conscripts finish their activities, system of management of users, activities, attendances and the others. The project needed to meet the following customer requirements:

- Physical servers & Databases have to be located in Finland
- Software has to be easily extendable in the future.
- Software should be extendable & scalable so that they can bring in more battalions & garrisons in the near future.
- Web mobile interface for sports instructors & conscripts is very important in this project
- Nothing fancy, a solid software with a smart UX that works and is light-weight to run on cloud
- Test suite over main functionalities would make more than sense on this one, since up-time requirements and basic functionalities quality requirements are high.

I discussed CTO and got a responsibility for almost all important functionalities of the project under the supervision of Project Manager. This paper will include a theory of technologies I used to build the application, it also explains in detail the logic of operation and the management of the application as well as the development process.

2 WEB APPLICATIONS

A web application is a type of program that has the ability to make the computer do directly things following the tasks that the user wishes to make.

Initially, websites only included text, image and video, linked together through links. The idea of the website was to store and display information. Users could only read, view and click links to redirect to another page.

Later, with the advent of server languages such as CGI, Perl, PHP, the website became "dynamic" and it could interact with the user. From that moment, users could use the website to perform a certain task by computer, thus the web application was established.

A web application is an application running on the web platform. Through the web app, users can perform many tasks: to calculate, to share photos, to do shopping. The interactivity of the web app is higher than that of the websites.

For the people, who lack understanding of IT, considering all the things, which are displayed on a browser or online, are a website. Therefore, they usually ask developers to set up a supermarket management website, a sales website. In fact, they are all web applications.

2.1 Advantages of web-based applications

Almost all web applications require a fast internet connection which must be easy to use. The strong development of the Internet is also one of the factors that promote the exploration and innovation of developers with web technology.

Unlike native applications downloaded and installed directly on phones, web applications are based on web browsers, thus, users only need to press a refresh icon to be able to immediately see the changes (if any) for the interface or to update a new version.

Many people say that if the native application can be designed impressively and gaudy with an appreciative interface, the web application looks simpler. In particular, along with the advancement of HTML5, JavaScript, jQuery Mobile has brought many fresh features for web applications. This is a big advantage for new web applications.

Society is increasingly developing and the need of using the smart phones has become more widely popular and necessary. If native applications have to depend greatly on the operating system (iOS, webOS, RIMOS, QNX, Android) and hardware (CPU, ROM, touch screen display), web apps will demonstrate the advantages of web-based applications: do not depend on the operating system but devices support the ability to access the Internet, CSS is an important factor in creating the interface as well as the compatibility with the device.

The native application is dependent on a music/video player software. For instance, the Adobe Flash format, which is a music/video player software, is only supported on some devices. The music and video of web applications depends on browsers that support it. Moreover, iOS devices use HTML5 to support the Flash format.

Currently, to native applications, the font is still a problem for many devices. Some new operating systems have been upgraded to support it relatively, but its support is still limited. However, the drawback of native applications can be improved through the institutional capabilities of the applications on a web browser.

In fact, native applications are only found on mobile devices. If a user wants to search other contents, the device will be connected to search engines by opening a web application. However, for web applications, a search module is the default function. This clearly is one of the advantages of web applications.

For a native application, there are difficulties in sharing between two operating systems if they have different platforms, such as iOS and Android, iOS and BlackBerry. However, native applications on Android can be installed on RIM's PlayBook tablet, but this is still limited. On the other hand, the ability to share web applications to other operation systems is simple. Just sending the link of the web application, the recipient will know what to do by clicking on the link to open the application on browsers.

The development of native applications will naturally require much time and resources to each separate product for each different platform (iOS, RIMOS, webOS, Android). On the other hand, for web applications, everything is very easy. The update process is simple, not to build the software from scratch and then publish, it just requires a simple operation.

For native applications, software developers need to ask for permission to put their products to the archive of online applications, such as Apple App Store, Blackberry App World, Google Play. On

the other hand, for web applications, a user can completely actively and easily share website links and information on the apps.

2.2 Why does the Finnish Defence Forces need a web application in management?

The Finnish Defence Forces has a huge database with a large number of users because there are thousands of young men apply for the military service every year. Therefore, they need to remove or deactivate old records of men who finished or left the army, and to add new ones. This work will take several weeks or even months to be completed.

Deployment tasks, notifications and orders from superiors to subordinates must be received quickly. Notifications features should be very helpful and easy to use with one input and one output model. Thus, the web application would always guarantee that information is transmitted without change.

Discipline is characteristic of the military, therefore, they want to monitor each evolution of the training process of conscripts. Each man has the operating process and the web application would help to track historical activities. It could work as a virtual assistant to help them be better.

A huge database of users requires a tremendous management system with a lot of manpower and financial resources. The web application would help to solve this with only one application along with computers and smart phones with the Internet connection. Money will be saved for the refurbishment of equipment and infrastructure.

3 BASIC TECHNOLOGIES

Web design has become very popular in many countries, regardless of age, occupation and education level. The coverage of smart mobile devices and high-speed internet network is growing. Most people use at least one or several web applications for their daily activities, such as reading newspapers and shopping, grasping the overall trend of the market, base technologies in programming are included in teaching programs so that students have opportunities to approach to this kind of high technology.

3.1 HTML

HTML (Hyper Text Markup Language) is a markup language designed to create web pages.

An Html document constitutes the source code of the web page. When it is viewed in editors, this document is a sequence of tags and elements, which define how the site is shown. The browser reads files with a tail such as .htm or .html, and shows that the site is according to the commands in there. HTML is very basic knowledge that anyone who wants to learn web programming or web design must know.

It is possible to use Notepad or other text editors to edit an HTML document.

The basic structure of an HTML document looks like the figure below

```
<!DOCTYPE html>
<html>
<head>
<title>Page Title</title>
</head>
<body>

<h1>This is a Heading</h1>
<p>This is a paragraph.</p>

</body>
</html>
```

FIGURE 1. Basic structure of HTML document (Refsnes Data 2014, cited 25.02.2017)

Browsers interpret commands and displays the site as though:

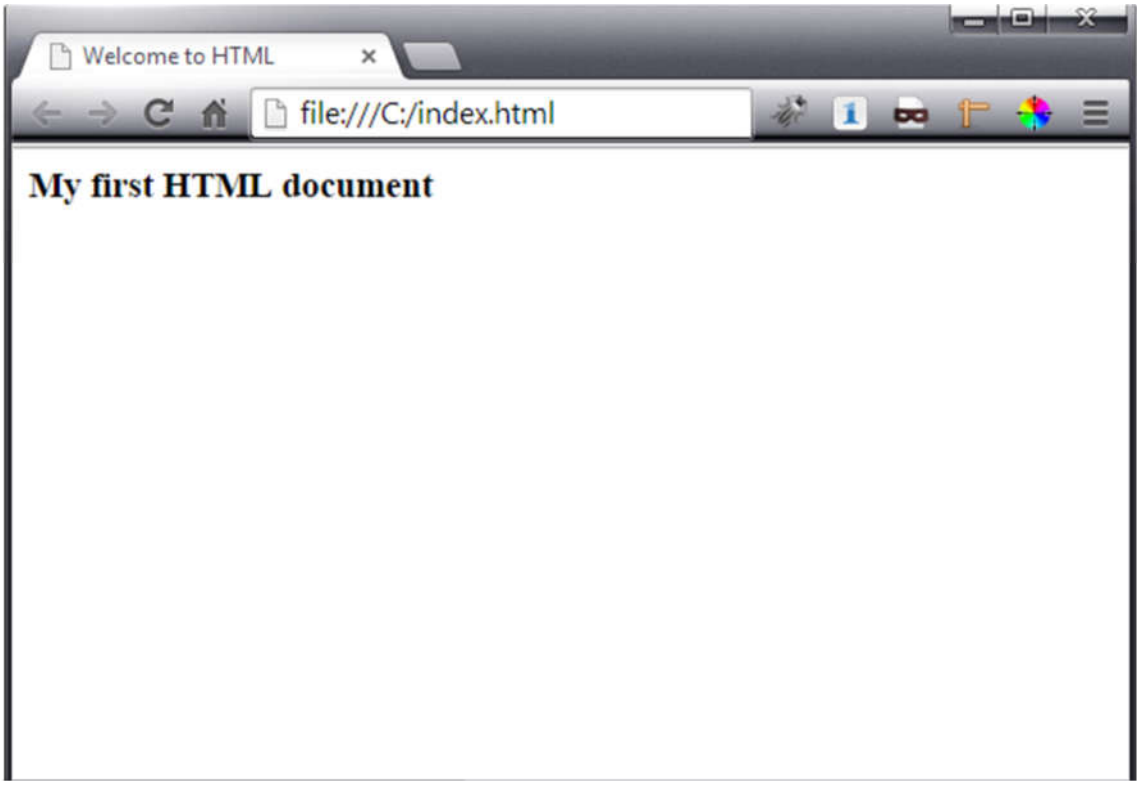


FIGURE 2. Browser inteprets commands and displays on the site (Refsnes Data 2004a, cited 25.02.2017)

An HTML document includes three basic parts:

- Html part: Every html document must begin with an opening html tag <html> and it must end with a closing html tag </html>. The Html tag tells the browser that the content between the two tags is an html document.
- Header part: This part begins with the opening tag <head> and ends with the closing tag </head>. It gives information on the website: the website title, description, website font and website files are inserted to operate. These contents are shown only in the address bar. They are not displayed on the browser. In the header part, it is possible to use meta tags shown in the figure 3 below:

```
<head>
  <meta charset="UTF-8">
  <meta name="description" content="Free Web tutorials">
  <meta name="keywords" content="HTML,CSS,XML,JavaScript">
  <meta name="author" content="John Doe">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
</head>
```

FIGURE 3. Metadata tag example (Refsnes Data 2004b, cited 25.02.2017)

- Meta tags are used to provide metadata for web pages. Meta data is not displayed on the website but it is a very important element for a search engine.
- Meta tags are often used to provide the description of the site, keywords, the author of the site and some other information.
- The metadata specified using meta tags can be used by the browser (a display content or a reload page), search engines, or other web services.

- Body part: This part is located after the header. The body consists of text, images and links that are displayed on the site. The body starts with the opening tag <body> and ends with the closing tag </body>

Almost all developers use an updated version of HTML 4.01 and XHTML 1.1 with the name HTML5. It includes detailed processing models to increase compatibility. It expands, improves and streamlines the markup available for documents. It provides a new marking and introduces a new application programming interface (API application programming interfaces) to create complex web applications. Furthermore, HTML5 is a potential candidate for a mobile application platform. Many features of HTML5 were built in a way that they could be used on mobile devices, such as smartphones and tablets.

3.2 CSS

CSS is an acronym for the phrase "Cascading Style Sheet". It is a language used to appoint the presentation of the web page with an HTML tag.

The rules of using CSS to display the contents of the HTML tag are almost the same on browsers, specifying the attributes for HTML tags.

Each command of the CSS will format a certain section of HTML, such as the font of the text, borders, background color, align of images.

By using CSS, developers can easily manage the content of an HTML page, as well as handle a format section, and especially, spend less time to edit the code. For instance, users have approximately 100 HTML files titled equally. If users want to edit titles, they have to open and edit each page in 100 files and it takes a long time to do it. However, if 100 files are linked with one CSS file, the header format in 100 files only takes a few minutes.

CSS can be used to customize the format of layout displayed content, background color, alignment, color, borders, shadows for html tags. If websites do not use CSS in HTML, then they will look very crude. It is like a motorcycle without the paint layer and outer jacket. It has only the frame and machine left.

CSS offers hundreds of properties for presentation objects with a high creativity and properties to help to bring efficiency to layout. In addition, in modern websites, there are many animations which make a website shimmering and CSS is the main factor for that.

Besides that, the current CSS is supported by all the different browsers.

This is an example of a basic structure of .css file:

```
body {
    background-image: url("img_tree.png");
    background-repeat: no-repeat;
    background-position: right top;
    background-attachment: fixed;
}
```

FIGURE 4. Basic structure of CSS file example (Refsnes Data 2004c, cited 25.02.2017)

3.2.1 CSS 3

Nowadays, developers have created a new version with the name CSS3. It has been evaluated as a revolution of designing a User Interface.

CSS 3 was built based on the origin of style, selectors and cascade of the old version, CSS 2.0. It allows to execute a number of new features, including new selectors, a pseudo-class and properties. By using new features, the design of templates will become much easier.

CSS3 was developed to increase the compatibility with HTML5 in the layout of the content. As a result of that development, the HTML document has a very clear layout and it is easy to understand. The CSS properties and HTML tags are now no longer overlapping but they are seperated clearly by the “class” and “id”.

Media Queries launched in CSS3 support for the compatibility of sites with many different screen sizes without editing the content shown. They increase the application's flexible properties.

CSS3 also helps to eliminate redundant codes in HTML, therefore using the HTML tag attributes is no longer needed.

3.2.2 Bootstrap Framework

Bootstrap is a CSS framework allowing to design a responsive website design faster and easier.

Bootstrap is included in HTML templates, CSS templates and JavaScript. It combines and creates basic available templates, such as typography, forms, buttons, tables, navigation, modals, carousels and image. In Bootstrap, there are JavaScript plugins which help to make the design look more beautiful and flexible.

It is very easy to use Bootstrap because it is based on HTML, CSS and JavaScript. Developers just need to have a basic knowledge about them to use the Bootstrap framework.

The Bootstrap framework is compatible with all browsers (Chrome, Firefox, Internet Explorer, Safari, and Opera) except IE with the old version, thus, IE9 to IE8 or the lower versions does not support Bootstrap.

When using Bootstrap, it can be completed to customize an interface with the default System Grid. The system includes 12 columns along with the width of 940px, a built-in of Bootstrap.

When website development trends are compatible with all devices, Bootstrap emerged as one framework which provided an available responsive CSS to fit to all devices, such as a smart phone, a tablet or a desktop.

There are 2 ways how developers can use Bootstrap on their web site.

- Downloading the Bootstrap packet from getbootstrap.com
- Adding Bootstrap from CDN.

3.3 JavaScript

JavaScript was created by Brendan Eich at Netscape in 1995. It was named as Mocha in the development stage and it was launched in beta form with the name LiveScript, and finally it was named JavaScript to stand by on the popularity of Java (a programming language) for marketing purposes. (Fankhauser, 2012, cited 28.02.2017)

JavaScript is a scripting language based on available objects or self-defined ones. It is used extensively in web applications and supported on almost all browsers, such as Firefox, Chrome and even the browsers on mobile devices.

If developers already know about HTML5, they also know about sessionStore or localStore, which are created by JavaScript. Therefore, JavaScript will exist as long as possible in the development of web application.

Moreover, also some web game applications used JavaScript to handle the operation on the client side. Normally, developers selected Flash to build web game applications but they had problems with the slow performance. Thus, JavaScript was selected as an alternative solution.

JavaScript is one of the few programming languages on the client side. Therefore, it is used on most web applications. This is one of the reasons why Codecademy (a website for learning programming) launched JavaScript as the first language for users to learn. Unlike traditional languages that are taught in the computer science department at universities, JavaScript is surely used in the work if someone starts working as a web developer.

Since JavaScript runs in browsers, developers do not need to download the software to be used. The only thing developers need to use is a text editor (such as, Notepad or Sublime) and a browser. This is a clear benefit for programmers.

Despite of the convenience, programmers do not consider JavaScript to a perfect language because it is also quite troublesome. CoffeeScript is an attempt to change that. It makes JavaScript

more like Ruby or Python by leaving braces and semicolons and inserting an additional white space and indentation. These changes are for the code easier to read, if programmers return to the old code and try to remember what was done, or a project is done by different programmers. (Sokolow 2011, cited 28.02.2017)

HTML5 is an innovative version of Flash. However, if HTML5 is an organization tool, JavaScript will be replaced by the Flash element. Videos or images were made by using plugins, but nowadays, they are made with JavaScript and they run on browsers, thus, users do not have to download a third-party plugin to view it, and developers know that people are having the same experience.

Everybody said that JavaScript has been hard to grow since it has been launched at the time Java was considered as the most popular programming language all over the word. However, a programming language is only good if its tools work well too, and thanks to timely additions, such as Node.js, jQuery (a library), JSON (JavaScript Object Notation) and MongoDB, JavaScript has a bright future.

This is a basic structure of JavaScript

```
var x, y, z;
x = 5;
y = 6;
z = x + y;
document.getElementById("demo").innerHTML = z;
```

FIGURE 5. Basic structure of JavaScript Example (Refsnes Data 2011, JavaScript Syntax, cited 26.02.2017)

3.3.1 jQuery

Along with the improvement of the Internet, users pay more attention to the appearance of a web page. Earlier, if a web page just included a banner, a content and a footer, it was considered as a complete website. But now, a web page must have an eye catching banner or content, and many other fancy effects so that it can attract readers.

Thus, web designers have started to pay attention to JavaScript libraries, such as jQuery to create effects that can interact directly with readers quicker and easier than using JavaScript.

CSS is a very powerful tool to format a web page, but its drawback is that it is not displayed the same on all browsers. Thus, the establishment of jQuery helps to fill this gap, developers can use it to make the site to be displayed well on most browsers. Moreover, jQuery can change the CSS class or the format has been applied to any components of the HTML document even if that site has been successfully loaded on the browser. Changing the content of the document. jQuery is not only able to change the appearance of website but it can also modify the content of that website with just a few lines of code. jQuery can add, remove or change the content on a page or rearrange the lists. Even the HTML structure of a website can also be rewritten and extended.

A JavaScript library, such as jQuery, gives developers more ways to interact with users. For example, when a user clicks on a link, then something will happen such as redirecting to some places, any effects (fade in, fade out). Thanks to Event Handlers, the HTML code is not messing up. Moreover, Event Handler API will ensure that users' site is compatible with most browsers. This has caused a lot of headache to many web designers.

To interact well with users, web designers have to let users see which effect will occur when they do a certain task. jQuery allows one to use a lot of dynamic effects such as fade, autocomplete, resizable and selectable. And if this is not enough, it will allow developers to manually create their own effects by coding plugins.

The fact is that, every browser system has an own type to read web pages. Web designers had difficulties to make a webpage shown well on all browsers. So that, sometimes they must do a system of complex codes to ensure that their websites are shown almost the same in the common browsers. JQuery helps developers to add a way for solving that problem on difference browsers and handling this process is much easier.

To avoid crashing into overload features, jQuery allows users to create and use plugins if needed. To create a new plugin is also quite simple. Thus, the jQuery community has created a series of innovative and useful plugins.

JQuery becomes more popular because it is quite simple to use. Besides, there is a strong community growing more plugins and improving important features of jQuery. Despite the strength of jQuery, it is absolutely free for everyone to use. Of course, it is protected by laws of the GNU Public License and the MIT License. One can use it in most of the cases, including commercial and personal versions.

This is a basic structure of jQuery:

```
<!doctype html>
<html lang="en">
<head>
  <meta charset="utf-8">
  <meta name="viewport" content="width=device-width, initial-scale=1">
  <title>jQuery UI Resizable - Default functionality</title>
  <link rel="stylesheet" href="//code.jquery.com/ui/1.12.1/themes/base/jquery-ui.css">
  <link rel="stylesheet" href="/resources/demos/style.css">
  <style>
  #resizable { width: 150px; height: 150px; padding: 0.5em; }
  #resizable h3 { text-align: center; margin: 0; }
  </style>
  <script src="https://code.jquery.com/jquery-1.12.4.js"></script>
  <script src="https://code.jquery.com/ui/1.12.1/jquery-ui.js"></script>
  <script>
  $( function() {
    $( "#resizable" ).resizable();
  } );
  </script>
</head>
<body>

<div id="resizable" class="ui-widget-content">
  <h3 class="ui-widget-header">Resizable</h3>
</div>


</body>
</html>
```

FIGURE 6. Example of using jQuery (The jQuery Foundation 2017, jQuery UI official Document, Resizable, cited 01.03.2017)

3.3.2 VueJS

Vue is a progressive framework used to build the user interface. Unlike the monolithic framework, the core of the Vue focuses only on the view layer and it is easy to use or to integrate with available libraries or a project. Moreover, Vue contains a great strength in building Single-Page applications combined with build tools and the library/component is built by a huge community.

Building JavaScript libraries is divided into two genres. One of them is operating in DOM, such as:

- Actual Dom.
- Virtual Dom

The other one based on design patterns:

- MVC
- MVVM
- MV

VueJS was built on the following ways:

- It is designed to use Virtual Dom. This is explained quite cleared by using the components in VueJS.
- It is based on the MVVM design pattern. When users interact with the interface (a view layer), Dom Listeners by VueJS will perform this event to handle and to process the corresponding information by taking from the Model and updating it again to View without having to reload the current page back to the user (a two-way data-binding). (Gore 2016, cited 01.03.2017)
- It uses two-way data bindings. A two-way data binding means that data is bound from the DOM back to JS. For example, what should developers do to change the value of a message in the DOM via an input? They just need to add an input to the document with an attribute v-model and assign it to the message property. As the result, if users type anything into their input, the JS variable is updated with the change, which it will in turn update span elements. (Gore 2016, cited 01.03.2017)
- Its API is quite easy to follow if someone has used over Angular JS. It just takes few hours to master VueJS.

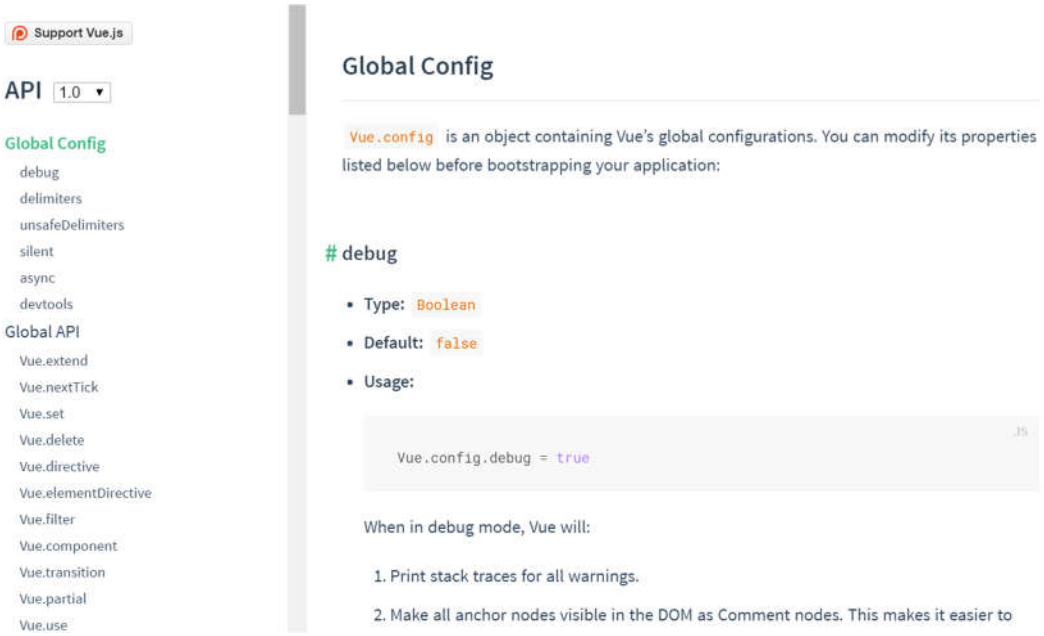


FIGURE 7. Example of API of Vue JS (Evan You 2015, VueJS Official Document, Global Config, cited 03.03.2017)

3.4 PHP

PHP is an open source server-side programming language designed to easily build dynamic web pages. PHP code can execute on the server to generate HTML codes to a web browser and output as requirements of users. PHP allows building web applications on the Internet to interact with any database, such as MySQL and Oracle. The PHP programming language is optimized for Web applications. It is also very fast and compact with syntax varieties with C and Java and easy to learn. As building projects takes shorter time than with other languages, PHP has quickly become a popular programming language in the world.

The development process has only operated for fifteen years but PHP has had a rapid development. For instance, there are some popular applications written in PHP, such as: Yahoo, Facebook, Wikipedia, Digg, Joomla and WordPress. The popularity of PHP in the web construction has made more and more websites deployed with PHP. Some typical web forms that can be written in PHP are: Social Network, Message Board (e.g. Forum, Guestbook, Blog), CMS (Content Management System), E-Commerce, Multimedia (e.g. Image Gallery, Music, Video), Web Mail, IM (Instant Message) and Office tools.

To run the PHP code, developers need to have a server environment because PHP is the language used on the server. To create an environment server, the best and fastest way is that developers use an XAMPP Installer package. The XAMPP installation package has integrated Apache, MySQL and PHP. XAMPP also includes PhpMyAdmin, a web tool for database administration programming, and for many other programming with supported libraries, such as OpenSSL and pdf class.

With the release of large applications written in PHP, the variety of applications and frameworks make the future of people having the passion in PHP be brighter. Many companies are choosing PHP as the main language of website development to clients as well as their own products. Thus the depth of knowledge and web technologies in general and PHP in particular, will be a huge advantage for developers.

3.4.1 Advantages of PHP

Developers will lose nothing in the progress of using PHP because it is an open source. There are many well-known products built on the PHP platform that programmers surely have heard of, such as WordPress, Joomla and Drupal. They are all free as basic.

PHP is supported on most operating systems, such as Windows, RISC OS, Mac OS X, Linux and many other variants of Unix. Likewise, the PHP Web Server also runs well on most Apache Web Server and IIS.

PHP supports a wide variety of databases. Additionally, PHP has an extension database with the name DBX. It allows programmers to use other database types supported by this extension. In addition, PHP supports ODBC and Open Database Connectivity. It provides a standard software API method for using database management systems. The aim of the designers of ODBC is to make the work independent of programming languages, database systems, and operating systems.

The concept of object oriented programming (OOP) was not strange to programmers. The capabilities and benefits of this programming model made many languages to have corresponding implementations to support OOP. From the version PHP 5, PHP has the support for most of the features of object-oriented programming such as Inheritance, Abstraction, Encapsulation, Polymorphism, Interface and Autoload. Today, there are more and more frameworks and PHP applications written in OOP. Programmers easily and quickly approach and extend these applications.

As PHP itself is an open source and has a very active development community, therefore it can be said that PHP is quite safe. PHP also offers a variety of mechanisms that allow developers to deploy security applications such as session, filter functions of data, technical cast and PDO (PHP Data Object) to interact with the database more securely. Combining with the security technology in the other layers, PHP will become more secure and ensure the good performance for website.

By being built on the platform of the C language and being open source so the possibility of extension for PHP applications can be said to be unlimited. With a rich and large library, the scalable PHP applications can interact with most types of popular applications, such as image processing, data compression, encryption, manipulate PDF, Office, Email, Streaming. Developers can build themselves extensions for the purpose of optimization, addition of functionalities to PHP as well as making PHP's Core to better serve for the purpose of expanding their website.

3.4.2 MVC Pattern

MVC stands for Model - View – Controller. This is a model created with the purpose of managing and building software projects more systematically. This model is used widely, especially in the web programming language. In PHP, currently, there are many frameworks and pretty much all of them are built in the MVC pattern, from which developers can easily see the importance of that model.

This pattern separates an application into three components to operate separate functions. It is more convenient for handling and maintenance.

- Model: responsible for data management, storage and retrieval of its entities from MySQL database, SQL server and PostgreSQL. It includes logic functions executed by the application.
- View: responsible for displaying data which has been retrieved from the model in a certain format according to programmers' intentions. View can be used with the same templates modules that are typically found in web applications, such as WordPress, Joomla.
- Controller: It can be called as an intermediate layer. It has a task of handling interaction between the model layer and view layer. Controller receives a request from a client, then it calls a model to perform that requested operation and send it out to View.

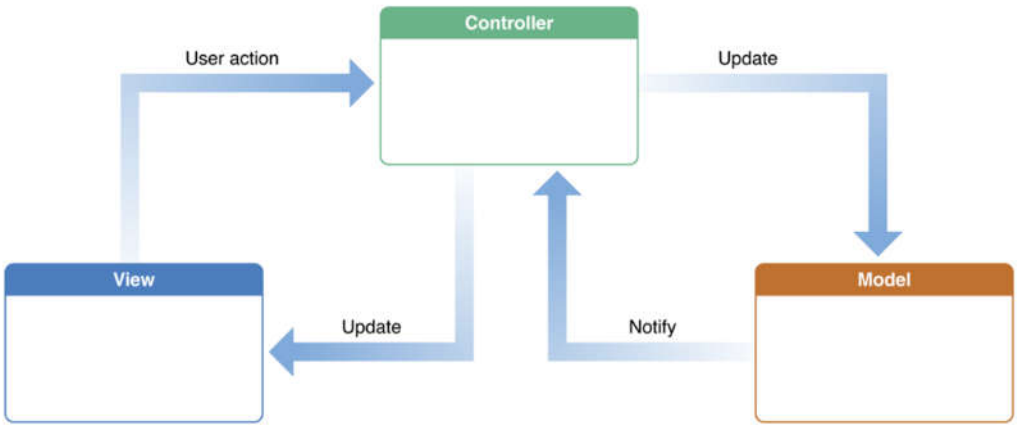


FIGURE 8. MVC Pattern diagram (Apple Inc 2015, cited 03.03.2017)

In the above figure, users use any web browsers (Firefox, Chrome, IE) to send requests (HTTP Request) which may be attached with the imported data to the corresponding processing Controller. The determination, which controller is used, will be based on a navigation routing.

When the controller receives the request, it will be responsible for checking if that request data needs a model or not? If so, it will use the class or function coded in the model and return the results, Then the controller will handle those results and return them to display to the view. The Controller will determine the corresponding view to display properly the requests.

When the view receives data from the controller, it will be responsible for the construction of the compositions of display as images, information and data and it will return the GUI content to the controller to make up results to the browser.

The browser will receive the return value (HTTP Response) and it will be visible to users. It is the end of an active process.

Pros	Cons
_ Projects can apply immediately the MVC model which is not dependent from the environment, construction platform or programming languages. _ Planning classes or functions into a separate components Controller - Model - View, then it will be easy to build, develop, manage, operate and maintain a project. It will create clarity and transparency during the project development. It will control the processing flow and create business process components to specification. _ By creating a standard model for many projects, developers will approach and learn these projects quickly and efficiently. If developers are familiar	_ Professional requirements are quite high needing sufficient knowledge of the standard model. _ The System will run slower than when coding from scratch with the origin PHP. _ It will be a problem if the implementation of projects is more complex. _ It takes time to build the library and the structure of pattern. _ Currently, there is a new concept model which is gradually replacing the MVC. It is HMVC (Hierarchical Model View Controller).

with the MVC pattern of a certain project, then when they access to a different project that they have never known or have contacted, if it was built with the MVC pattern, it would not be extremely difficult to use. _ It helps professionals, managers, and investors to be able to understand how a project performs or to help programmers easily in management and development. It is not only the language, but when they look at it they will understand what it is. Then they can exchange and discuss work and customer's requirements together. _ This is a standard model. It is the most optimal one compared to many other models used in many projects and areas, particularly in the manufacturing technology applications and software. Programmers use the MVC standard model easily in the distribution and transfer technology.	

3.4.3 OOP

OOP (Object-oriented programming), is a programming methodology, which takes objects as a foundation to build algorithms and construction programs, to improve the productivity and to simplify the development and maintenance of software. It uses DRY principle – DON'T REPEAT YOURSELF (that means that do not repeat codes) - to ease of maintenance problems and to increase efficiency of the job.

If developers build a website or a system with thousands or even millions of lines of code, the code system is written in the classical direction. The result is a web page that contains HTML, PHP and

JavaScript mixed and mingled together. When the webpage sometimes encounters a certain problem, or is merely fixed with a few small sections because customers change their requirements, developers must scour the whole of codes and fix parts of duplicated codes. This is truly a nightmare for programmers. Therefore, OOP was created to help developers to solve this problem.

There is an example of OOP in below figure:

```php
<?php
class Foo {
    public $aMemberVar = 'aMemberVar Member Variable';
    public $aFuncName = 'aMemberFunc';


    function aMemberFunc() {
        print 'Inside `aMemberFunc()`';
    }
}

$foo = new Foo;
?>
```

FIGURE 9. Example of OOP in PHP (The PHP Group 2009, cited 16.03.2017)

In OOP, we have some basic concepts:

- Class: A data type users define and gather many characteristic attributes to all objects created from that class. Properties are variables or methods.
- Object: They are things that they have the same nature, characteristics and similarities. They can be collected into an object.
- Instance variables: variables defined inside a class or an object. They are properties of that object when an object is created.
- Method: function is defined in a class and it is used to access the data of that object.

In addition, OOP has some special features to help developers to execute easily complicated problems:

- Magic methods are named with special characters, beginning with two underscores. When a method is named with two underscores as prefixes, it is a sign to PHP to recognize magic methods, and it will activate the special features of this type of method. It sounds

complicated, but essentially, it is quite simple. They are merely functions built with aims to perform a certain useful task for programming. (The PHP Group 2009, cited 16.03.2017)

- Scope is not very strange to programming. The purpose of the scope in PHP is to increase the ability to control objects, methods, and properties that they have assigned additional scope values. It allows developers to control access (how and where) to properties and methods. There are 3 types of scopes to attributes and methods which are: public, protected and private. In addition, the static is as well a type of a variable scope. It allows developers to access the properties or methods without an initialization class. (The PHP Group 2009, cited 16.03.2017)
- Abstract class and interface is the premise of the principle of SOLID in PHP. (The PHP Group 2009, cited 16.03.2017)
- Inheritance, assuming that developers have one parent class, has attributes and methods. Then other classes inherit that parent class Then they will inherit and reuse methods and properties of the parent class. (The PHP Group 2009, cited 16.03.2017)

3.5 MySQL

MySQL is a free open source database management software in the group LAMP (Linux-Apache-MySQL-PHP). MySQL is very popular and developers prefer it in the application development process. MySQL is a database of high speed, being stable and easy to use. It works on many operating systems and provides a great system of utility functions. By speed and high security, MySQL is very suitable for access database applications in the Internet. Because MySQL is entirely free, developers can download MySQL from its home page.

MySQL has many versions for different operating systems: the Win32 version is for operating systems, such as Window, Linux, MacOS X, Unix, FreeBSD, NetBSD, Novell NetWare, SGI and Irix (Oracle Corporation 2017, cited 29/03/2017)

MySQL is one of the very basic examples of database management system of relations using a structured query language (SQL).

MySQL is used to support to PHP, Perl and many other programming languages It is a tool for storing information on websites written in PHP or Perl.

Pros	Cons
_ MySQL is a fast-compact management system, secure and easy of use. It is usually used for small and medium applications. Script files can be run on several other management systems, such as Oracle and MySQL server. It is used for client-server applications with powerful servers such as UNIX, Windows NT, Windows Server, and especially on the UNIX server. _ MySQL supports the SQL92 ANSI and ODBC. MySQL supports many languages for error messages, such as Czech, Dutch, English, Estonian, French, German, Hungarian, Italian and Norwegian Nynorsk. The default language for the data is MySQL character set and collation (latin1, latin1_swedish_ci). (Oracle Corporation 2017, cited 29/03/2017) _ The programming language used to write the MySQL database entry could be C, Perl or PHP. _ The table in the MySQL database is very large and it also depends on the size of a file by the specified operating system. _ The MySQL database is very easy in management and its processing speed is three or four times higher than that of the other database management systems.	_ There is no graphical environment. _ Privileges for a table are not automatically revoked when you delete a table _ MySQL does not support stored procedures, trigger, transactions, View and Foreign keys like the other database management system.

4 LARAVEL PHP FRAMEWORK

4.1 Introduction

Laravel was launched in June 2011 and its father is Taylor Otwell. It is a new framework, but in return its manual is quite complete, easy to understand and has many attractive advantages. If developers have worked with other frameworks or just been beginners in learning PHP frameworks, it is also not the problem. (Surguy 2013, cited 16/03/2017)

Laravel is an open source programming language. It is a framework used for building a web application and it is designed based on the MVC Pattern (Model, View, Controller). The entire source code is located on Github. According to the results of developers survey in December 2013, Laravel Framework stood at top as one of the most popular PHP frameworks, followed by Phalcon, Symfony2, CodeIgniter and other frameworks. In August 2014, the Laravel framework was viewed as one of the most popular PHP projects on Github. (Chowles 2015, cited 16/03/2017)

Currently, developers released LTS (long time support) versions of Laravel. The bug fix will be supported within 2 years since the launch and within 3 years for the security fix. It is a long enough period of time so that programmers have time to access and upgrade to a newer version. Laravel 5.x is among LTS versions. (Korop 2016, cited 16/03/2017)

Philosophy of Laravel developers:

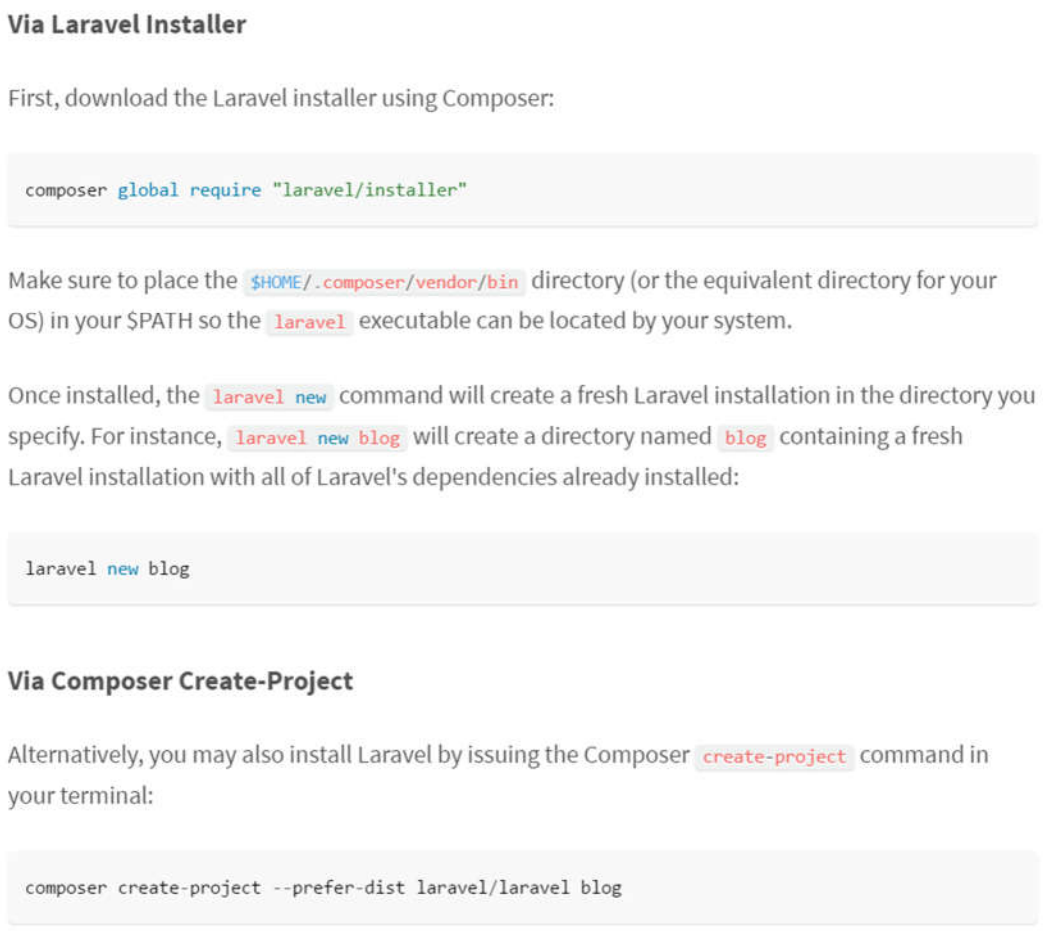
- Laravel is a framework for the web application development with the expressive and elegant syntax. They believe that development should be a pleasant experience and full of creativity. Laravel helps developers to erase the suffering by reducing the difficulties of common tasks in web projects, such as authentication, routing, session and caching. (Otwell 2009d, cited 16/03/2017)
- Laravel aims to help the development process to become pleasant to developers without scarifying the functionalities of the application. The best codes will be generated by happy developers. To obtain this, they have tried to incorporate a lot of great things that have been seen from the other web frameworks, including the framework using other languages such as Ruby on Rails, ASP.NET MVC and Sinatra. (Otwell 2009d, cited 16/03/2017)

_ Laravel is accessible, powerful and provided with the tools necessary for large applications. Advantageous features, such as the inversion of control container, expressive migration system and tightly interacted PHP Unit testing give programmers great tools to build any applications or any duties that they are assigned. (Otwell 2009d, cited 16/03/2017)

4.2 How to Install Laravel Framework

It is easy to find the installation of the Laravel framework from the document of Laravel. It depends on different versions. Developers will have corresponding methods. However, in general, there are basic ways:

_ Downloading the Laravel installer using the Composer.
_ Installing Laravel by issuing the Composer *create-project* command in the terminal.



Via Laravel Installer

First, download the Laravel installer using Composer:

```
composer global require "laravel/installer"
```

Make sure to place the `$HOME/.composer/vendor/bin` directory (or the equivalent directory for your OS) in your $PATH so the `laravel` executable can be located by your system.

Once installed, the `laravel new` command will create a fresh Laravel installation in the directory you specify. For instance, `laravel new blog` will create a directory named `blog` containing a fresh Laravel installation with all of Laravel's dependencies already installed:

```
laravel new blog
```

Via Composer Create-Project

Alternatively, you may also install Laravel by issuing the Composer `create-project` command in your terminal:

```
composer create-project --prefer-dist laravel/laravel blog
```

FIGURE 10. Installation of Laravel Framework (Otwell 2009a, cited 16.03.2017)

4.3 Basic main features of Laravel

Composer: developed in the Laravel version 4.x, it is used as a management tool with features, such as adding the installation package, additional plugins for Laravel stored in Packagist.

Eloquent ORM (object relation mapping): mapping of objects and relational databases, providing the internal methods to execute them. Besides, it also supplements the limited features of the relationships between objects in the database. Eloquent ORM presented the tables in the database in classes, providing additional options to access the database directly fresher and more professional.

Application logic: as a part of the application development, it is used by controllers.

Routes: defines the relationship between paths (url) and links. When a link is created using the name of routers, then a unified identified link will be created by Laravel.

RESTful Controller: provides options to define logics behind the requests using HTTP POST, GET.

Class auto loading: provides importing automatically classes in PHP, which does not need to include classes manually. Depending on the requirements, it will restrict unnecessary classes to be loaded.

View: includes html codes and shows data specified by controllers

Migrations: it is simply a PHP source file inside an application's migrations folder. Each file contains a discrete set of changes to the underlying database. The Changes to the database are made in PHP rather than a database-specific flavour of SQL. The PHP migration code ends up being converted into the DDL specific to your current database. This makes switching database platforms very easy. Laravel migrations are run explicitly from a command-line using the artisan tool.

Unit Testing: plays a key role in Laravel, Unit testing contains a lot of systems of unit tests to help to detect and prevent errors in a certain framework. Unit Testing can be run via a command-line utility.

Automatic pagination: It is integrated into the Laravel to help to simplify the task of implementing paging versus other conventional methods.

5 CREATING LIIKKURI PROJECT (A WEBSITE FOR THE SPORTS MANAGEMENT OF FINNISH DEFENCE FORCES)

5.1 Requirements of Liikkuri Application

5.1.1 Status

In the era of information technology, science and technology are growing and everything is managed and developed by computers and web applications. Especially, information technology is applied in economic, political and social areas. Applications are considered as one of the critical factors in the operation of national organizations and throughout stores.

By the Internet, people have done tasks with a faster speed and a lower cost than in traditional ways. Realizing the importance of it in the period of budding web applications, the Finnish Defence Forces ordered a web application to be built from scratch based on the PHP language platform ten years ago. At that moment, the Laravel PHP Framework was not launched and their demands were very basic. In general, their requirements were like these:

- Showing the logo of the agency and title with the content of sports management for Finnish Defence Forces in Helsinki area.
- Showing some symbolic images of the activities in the garrison.
- Short introduction of the garrison and its image.
- Advertising and introducing sports activities in the garrison.
- Contact information of administrators.
- Authorization only for administrators to adjust the content of the website.

For the purpose of a basic management of the website, they did not need updated versions of the website or any maintenance service after that. They have been using that website for ten years but most of the paperwork has been done manually with paper and pen.

5.1.2 Customer's Requirements

There are more than five garrisons over the country and one thousand of young people needed to be registered for military service every year. This means a huge amount of documents and plenty of paperwork. In addition, the requirements of management are complicated and urgent. Thus, they needed a web application which would help them to execute the following requirements:

- Physical servers and databases should be in Finland.
- The application should be easily extendable and scalable so that they could bring in more battalions & garrisons soon.
- The Web mobile application interface for sports instructors and conscripts would be very important.
- They would not need anything fancy, only a solid software with a smart UX that would work and be light-weight to run on cloud.
- Test suites over main functionalities would make more than sense on this application, since up-time requirements and basic functionalities of quality requirements are high.

This application would be used by hundreds of thousands of people at the same time therefore, the host server should be in Finland. Compared with the previous version, this application should offer an improvement as an almost completely new application where many very significantly functionalities were added to match the current needs. A trial version was released in January 2017 in the Helsinki garrison and it will be extended to another institution if the application reaches effectiveness.

This application was aimed at users with smart phones so that the user experience design and mobile interface were very important factors. Light memory and high performance were also the priorities of the first trial because there are over tens of thousands of conscripts only in the Helsinki garrison.

Although many features were added to this web application, the main purpose was to help to reduce paperwork, to store an enormous database of profile system of conscripts, to closely monitor sports activities of conscripts and to transmit messages and notifications timely to lower levels (garrison admins and instructors).

Based on those requirements above, Finternet Group company decided to choose the Laravel PHP Framework as the core platform to build the application and they named the project as Liikkuri.

5.1.3 Scenarios

Joel Laitinen said that “As an admin, I look forward to being able to log in to the application and access the management page dedicated to me. I want my account to be very secure because I am the highest manager. Inside the admin page, I would like to see a taskbar on the top with a mobile UI and on the left side a group of buttons which link me to functional pages with desktop UI. My main responsibility is to consider applications for joining the military service and to make decisions to accept or reject them, to approve promotion applications for conscripts, to give notifications in the level of garrisons, to review activities of the garrisons to have proper adjustments and to guarantee training of outstanding soldiers for the Defence Forces. What I want from a software is that it should help me to solve as much of the above-mentioned tasks as possible. It can act as an assistant to help me to have a look of the most accurate in the operation of garrisons in the shortest possible time.”

Pekka Willing said that “As a garrison admin, I am the highest authority and responsible for the operation of my garrison. I would like to have an account to access to the management page dedicated to me. My main tasks are to allocate conscripts to corresponding units, to review daily sport activities of conscripts, to permit holiday applications based on conscripts’ rewards, to list academy calendar and sports events calendar to conscripts. I must take responsibility for a bunch of work so I am usually stressful and my work process is so slow. I need an application which I can use to manage those tasks and quickly make my decisions. One more thing, I can be rotated to other positions in other garrisons by the admin so I do not want that my tasks were congested for a long time.”

Leo Mansikka said that “As an instructor, I was appointed by a garrison admin. Basically, I am a conscript with a good grade in training and I got this position for the short period. I am just responsible for checking in and checking out conscripts when they participate in sports events. After that, I have to give that list to the garrison admin to summarize points and rewards to conscripts. I need an application with the feature that helps me to manage the above task. By that, I can avoid mistakes such as checking in or checking out a wrong person, forgetting to check out someone or be cheated by clever conscripts.”

Maruko Makela said that “As a conscript, I joined the army hoping that I will have an opportunity to devote to the country in the future. When the war happens or the country needs me to their tasks internationally, I want to be ready at any time so I need to train health and knowledge in the best. Therefore, I usually take part in sport events. My difficulty is that it takes too much time for me to run to the notice board or to ask my supervisor about the events and the result is that I missed them some times. I need an application which has the feature to list sports events according to the order of time and which includes approved conscripts to that event. I also need an overview of events that took place in other garrisons and results of good conscripts in the other units. It will be a motivation for me during the training in here.”

5.1.4 Expected Features

Authorization

There are four basic styles of users authorized in this application. They are admin, garrison admin, instructor and conscript.

The Admin is a person who has the highest power to manage all garrisons in the country. He can transfer tasks of subordinates between garrisons or pass decisions to expel a person from the military service course.

The Garrison admin is a person who has the highest power only in his garrison to manage activities and persons in his garrison.

The Instructor is a person who has a good grade in training course and he is appointed by the garrison admin to manage the participation to sports activities of conscripts in a short period.

The Conscript is a person who joins the military service course.

Authentication

Authentication is the first necessary step to access to the application. Users must log in or register his/her identity. After registration, the user will be notified to his/her email. Then admins will review their status before sending them credentials to access to the application.

CRUD for Users

This feature is only meant for the admin and the garrison admin.

Admins can create/deactivate/edit membership of conscripts. Moreover, they can exchange tasks of conscripts or garrison admins.

Garrison admins can edit information of conscripts belonging to their garrisons.

There are inputs to fill in the basic information of users and to select boxes for garrisons and units.

CRUD for Sport Activities

The Admin can create/edit/delete information of a sport. The names of sport must be unique.

Information of a sport should include only the name of that sport.

CRUD for Units

The Admin or Garrison Admin can create/edit/delete information of a unit. There may be units with the similar names in other garrisons.

Information of a unit should include only the name of that unit.

CRUD for Upcoming Events

The Garrison admin or any conscript can create an event for the garrison they belong to. However, all of them have to be first approved by the garrison admin. Then they will be shown on the main page.

The Garrison admin can edit/delete all events belonging to their garrison. In cases of restriction, instructors or conscripts just edit/delete events that they created.

Upcoming events should include a name, a description, a number of participants, a date and a time.

Calculating Reward System

Participation in events will bring cumulative points for conscripts. Rewards work as holidays and motivation for their training. By finishing a sports event, they can get one point or just a confirmation. It depends on other garrisons. Then they will get a reward when they reach ten or fifteen points based on the garrison. When they get maximum rewards of their ranks, they will not be calculated

anymore with joining to sports events. This helps them to avoid training because too much exercise leads to exhaustion.

This feature is very nice. It includes a smart calculation system along with a circle diagram showing all necessary information about how many points they get and how many points should be gathered to get the reward.

Sorting

Columns on tables will be sorted alphabetically or by time, by approval.

Redirect to corresponding pages

By using the middleware of the Laravel Framework, users will be redirected to the corresponding pages based on their rights, demands and identity. This functionality will help users to immediately access the pages they want and to prevent smart and slim people from interfere the management pages or the people's pages.

Booking Events

This feature is for conscripts who would like to book an upcoming sports event based on their vacancy. If they reserve an event, the booking functionality will be removed from them. In addition, they also have the right to remove the booking before the event happens.

Check in/ Check out Attendances

This feature is for instructors who are responsible for verifying participants and making sure that every participation is valid and legal. In the case of inactive internet, they can manually check in or check out participants later.

In the future, the application will be developed with an additional feature with a barcode scanning system for checking attendances. It will be updated in later releases.

5.2 Implementation

5.2.1 Configuring the working environment

The text editor which was used is NetBeans IDE 8.2 integrated with Git tools and PSR2 checking plugins. In addition, there are other text editors, such as Atom and Sublime Text 2. Atom and Sublime were chosen because they are open source software, not only free to use but also flexible to change the source code of the software. Based on projects, programmers are free to add more plugins to make coding be convenient and quick.

As the main platform is the Laravel Framework 5.3 thus, Virtual Box 5.1, Vagrant 1.9.3 and Homestead 1.0.1 were installed.

Homestead is a development environment for web applications, originally developed by the Laravel development team. It can run on Windows, Mac or Linux. Moreover, it includes the web server Nginx, PHP, MySQL, Postgres 7.0, Redis, Memcached, Node, and all the other software that programmers need to develop Laravel applications.

Vagrant is a product of HashiCorp. It is a tool which helps to build a development environment. In a basic way, Vagrant would be the bridge between a personal computer and a virtual machine. Developers still work on their machine as usual, and Vagrant will automatically syncronize it to the virtual machine, and the virtual machine will do tasks of compiling and interpreting.

Virtual Box is a free virtual server software, a cross-platform, which allows installation on multiple operating systems, such as Windows, Linux, Mac OSX and Solaris computers. After installation, programmers can create and run multiple virtual machines with different operating systems simultaneously on one personal computer.

Github is the tool used to clone/push/merge source codes with other teammates. Bamboo CI Server is configured to check and approve pull requests from developers.

5.2.2 Design Home Page

FIGURE 11. Home page (Finternet Group Finland Oy 2017, cited 20.03.2017)

The homepage was designed by using the construction and format of Bootstrap 3.3.7 integrated inside Laravel 5.3.

The Sass Language was used to configure the interface of this page and that of others. The Background was given by customer. Colours and Fonts were regulated by designers and allowed by customers. Icons were designed with SVG formats.

There are related animations, such as a box shadow and a scale transform to increase the interaction with users.

The main purpose of this page was to make an impression to users about Finnish Defence Forces with traditional colours presented to three main forces of army, air force, navy and infantry. Then it was included three buttons with two functionalities to link users to the sign in page and the sign-up page.

5.2.3 Database

The Database connection is used with MYSQL and supported with the phpMyAdmin tool. The main language is Latin1_swedish_ci. There are nineteen tables with relationships, such as many to

many, one to many together. Indexes used to retrieve data quickly are e.g. email, QR code, unique name.

To interact with the database in this project, developers used Eloquent ORM (Object-relational mapping) by creating models. Eloquent ORM provides ActiveRecord which is a full, clean and simple to work with database. Each table of the database will be reflected through the model, and this model is used to interact with the table.

```php
<?php

namespace App;

use Illuminate\Database\Eloquent\Model;

class Book extends Model
{
    /**
     * Get the author that wrote the book.
     */
    public function author()
    {
        return $this->belongsTo('App\Author');
    }
}
```

FIGURE 12. Example of a model in Laravel (Otwell 2009e, cited 16.03.2017)

The most basic and important of Eloquent is that it is automatically mapping the attributes of the model with the columns of tables in database. This will save developers a lot of time lost in the declaration model. When developers need to manipulate data, they simply call the correct names of table column and they can get or set data to the corresponding attributes.

In the Eloquent ORM, each table of the database is corresponding to one model, thus developer need to create an Eloquent model inside the *app* folder. Each Eloquent model is extended from the *Illuminate\Database\Eloquent\Model* class.

Eloquent ORM is very powerful. Developers of the Laravel Framework made many useful methods and attributes in Eloquent ORM served to interaction with the database. In addition, Eloquent ORM also provides softDelele, scope, and events boot (creating, updating, created, updated, saving, saved, deleted, deleting, restoring, restored) which enable operations with the database easier.

5.2.4 Authentication

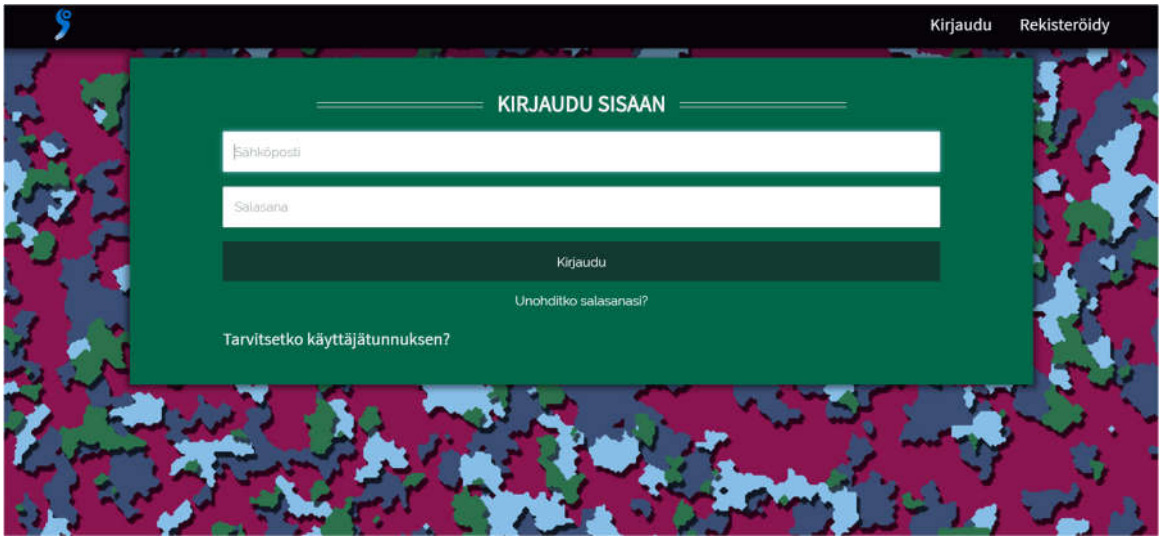


FIGURE 13. Log in Page (Finternet Group Finland Oy 2017, cited 20.03.2017)

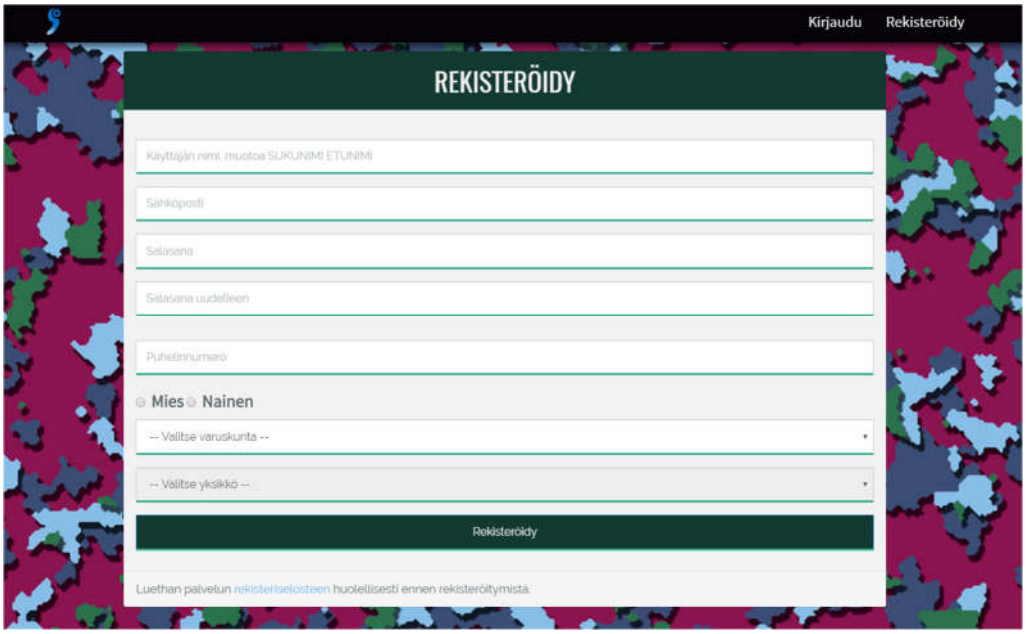


FIGURE 14. Register Page (Finternet Group Finland Oy 2017, cited 20.03.2017)

Developers of Laravel helped to make the authentication simpler. In fact, almost everything was configured. Authentication configuration files are in the file *config/auth.php*, including some customized instructions for refining the way of processing the Authentication Service.

In its core, the basis of Laravel's authentication is generated by the *guards* and *providers*. Guards define the way a user is authenticated for each request. For example, Laravel uses a session guard, which is used to maintain the status, it includes a session storage, cookies and a token guard, which authenticate users by an "API token" which is transmitted with each request.

Providers define how a user has been retrieved from a persistent storage. Laravel supports for accessing the user using Eloquent and Query Builder.

Laravel brought four great authentication controllers, which are located within the namespace *App \ Http \ Controllers \ Auth*. The *RegisterController* handles a new user registration, the *LoginController* handles authentication, the *ForgotPasswordController* handles e-mailing links for resetting passwords, and the *ResetPasswordController* contains the logic to reset passwords. Each of the controllers uses a trait to cover their necessary methods. For many applications, developers will not need to modify the entire controllers. (Otwell 2009b, cited 19.03.2017)

In this project, developers used an additional plugin *kris/laravel-form-builder 1.9* to build forms, such as the register form. It is a package made by Kristijan Husak. It was first released on 18 October 2014 and it is updated constantly by the author to support the latest version of the Laravel Framework. By using the Kris/laravel-form-builder, the forms used are very easy to modify and reuse. Basically, forms were created in the *app/Form* folder following the structure:

```php
<?php namespace App\Forms;

use Kris\LaravelFormBuilder\Form;

class LoginForm extends Form
{
    public function buildForm()
    {
        $this
            ->add('username', 'text')
            ->add('password', 'password')
            ->add('remember_me', 'checkbox');

        // This data is passed as 3rd parameter to `create` method
        // in the controller
        if ($this->getData('is_admin') === true) {
            $this->add('roles', 'choice', [
                'choices' => ['admin' => 'Admin', 'manager' => 'Manager']
            ]);
        }
    }
}
```

FIGURE 15. Example of basic structure of form builder (Husak 2014, cited 20.03.2017)

Then, controller will use *FormBuilderTrait* to call that form as shown in the following figure:

```php
<?php namespace App\Http\Controllers;

use Kris\LaravelFormBuilder\FormBuilderTrait;

class AuthController extends Controller
{
    use FormBuilderTrait;

    public function login()
    {
        // Note the trait used. FormBuilder class can be injected if wanted.
        $form = $this->form('App\Forms\LoginForm', [
            'method' => 'POST',
            'route' => action('AuthController@postLogin')
        ], ['is_admin' => true]);
    }

    public function postLogin()
    {
        // Code for logging in user...
    }
}
```

FIGURE 16. Example of using form builder in controller (Husak 2014, cited 20.03.2017)

Validation integrated in the *Kris/laravel-form-builder* also obeys strict rules of the Laravel validation.

The Operation of registration form and login form is shown below:

- Users without a verification were redirected to the login page by using the middleware *web* in *app\Provides\RouteServiceProvider.* The Middleware acts as a filter layer to prevent access to the wrong direction.
- Then, users with a demand of new registrations would fill out their information to the registration form. Information would be validated by Laravel rules before it was executed and saved into the database.
- In case that users forgot their passwords, *ForgotPasswordController* would handle it and Laravel would use Mail Notifications to send a reset password email to users.
- On the other hand, users would log in with their credentials. Their credentials would be validated and authenticated by *LoginController.*

Passwords would be hashed using the md5 encryption before they would be stored into the database. Thus, the authentication in Laravel has high security.

5.2.5 Authorization

In this project, developers used the middleware to authorize users to corresponding routes. Middlewares were assigned to routes in the *routes* folder and in the file *RouteServiceProvider* in the *app/Providers* folder.

After login with credentials, information of users would be retrieved along with their roles. Developers used *zizaco/entrust 5.2*, an additional package to Laravel, to handle the roles of users. This package was installed by a composer to Laravel. Then, four tables were created: *roles, permissions, role_user, permission_role.* It also provided useful methods and attributes to interact between users and their roles such as hasRole, can, ability, routeNeedsRole, routeNeedsRoleOrPermission. The Middleware would be responsible for checking their roles and redirecting users to suitable routes.

For example, admins would be automatically redirected to the admin route where they can go to pages they have rights to access. People with other roles could not be accessed to the admin role. However, the admin can access to almost all pages belonging to the others. In this project, the authorization is arranged in the following manner: The admin has the biggest rights to access to almost all routes. The garrison admin has smaller rights than the admin. Then conscripts have rights to access in the lowest level.

In addition, developers also used a very nice functionality of Laravel to authorization. Policies will define the rules relating to one model or a specific resource. It is a simple way to check users' permissions. Somebody said that the middleware and policy had the same functionality therefore, it was not necessary to use policy if there was the middleware inside the application. However, it can be imagined that the middleware is like a big gate and it operates at the authentication level. Once users passed the route middleware, they can do what they want and it is very messy if developers have to write to another middleware with a very small logic to check whether users have a permission to do that thing or not. Thus, the policy will help developers. They are methods and helpers to assist developers in the organization of authorization logic. The Policy usually includes four basic methods: view, create update and delete. (Otwell 2009c, cited 16.03.2017)

```php
use App\Post;

if ($user->can('create', Post::class)) {
    // Executes the "create" method on the relevant policy...
}
```

FIGURE 17. Example of use policy (Otwell 2009c, cited 16.03.2017)

5.2.6 CRUD

This application includes the CRUD system of user, sport, article, unit and upcoming event. They were built almost the same with the controller, VueJS, Kris/laravel-form-builder and repository. The Controller in the MVC pattern plays a role, such as a headache, to connect between the model and view. Thus, in this application, the controller will handle the requests of users to show the tables of users, sports, articles, units and upcoming events or editing/deleting that data. Vuejs played a role in the user interface of showing information from the database to tables and handling the inputs imported from users with the vue-resource package. It can process get/set/validation of data.

The Repository is a design pattern in Laravel. It is simply a rule of structural design application. In short, it has only 2 rules:

- Modules at a higher level do not depend on the module at a lower level.
- Abstractions are not dependent on a specific classis which is opposite.

Using the repository pattern has the following advantages:

- Minimizing a lot of duplicate code.
- Quick: It may take a little time to prepare the base, but then, all things are ready for developers to use. This is an inevitable result of reducing duplicate code.
- Minimizing errors: The chassis has been built before. The necessary elements are certain to have been bound to declare. By this approach, even juniors involved in the project can also easily write code in strict standards.
- Reducing the effort of maintaining: codes are more readable and the focus on data access logic means that when there are any changes, maintaining codes is easier.

In this application, developers applied the repository design pattern to build CRUD systems. A RepositoryInterface was created with basic methods, such as find, create, update, delete and list. Then, smaller repositories corresponding with user, article, unit, sport, upcoming event would extend the Repository class and implement RepositoryInterface. In the case of storing or deleting data, in the controller, developers will call repositories and use their methods. In case of changing the logic of those methods, developers just have changed the logic inside repositories.

5.2.7 Reward System

FIGURE 18. Example of reward system in mobile view (Finternet Group Finland Oy 2017, cited 20.03.2017)

FIGURE 19. Example of reward system in desktop view (Finternet Group Finland Oy 2017, cited

As mentioned above, the reward system was built in the purpose of motivating sports training of conscripts and calculating holidays to them. Developers used a RewardTrait to return points and rewards after calculating them.

Trait could be understood as a class, which gathered a group of methods that developers wanted to use in other classes. Like Abstract Class, developers could not create an object from Trait.

Traits offered a great solution for avoiding complicated inheritance multiple layers of a single inheritance language, such as PHP. In fact, sometimes it could be said that Traits has been created to solve the problem of multiple inheritance in PHP.

Traits allowed to add functionalities and methods to a class without complicating or repeating the code in that class.

Calculating rewards was a complicated logic therefore, developers did not want to make controllers so fat. Thus, they created a RewardTrait.

5.2.8 Booking system

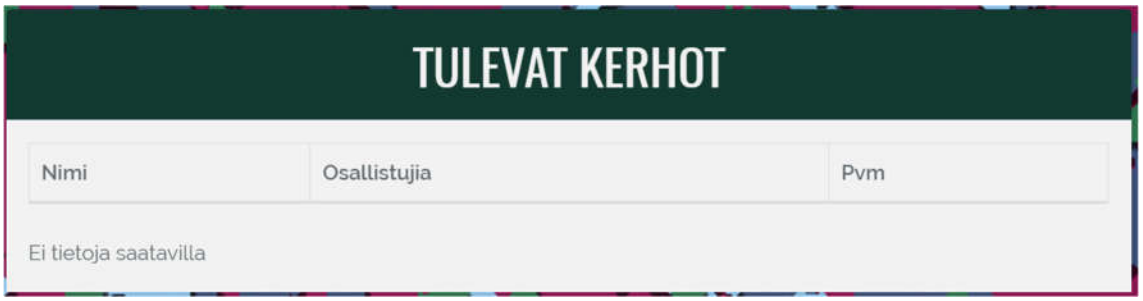


FIGURE 20. Example of table of upcoming events (Finternet Group Finland Oy 2017, cited 20.03.2017)

The above table is used to show a list of events happening in the future. They were listed along with the system of buttons on the right side. In the case of conscripts, there is only one button with the name *book.* Conscripts will choose an event they want, then they press the book button and the information will be stored into the database.

The booking system was operated by using the methods of vue-resource and controller of Laravel. When a user books an event, Vue will send id of that conscript and id of that event to the server. The database will create a record. When that user signs in to the event, that record will be updated. That is very basic and shows how the booking system operates.

5.3 Testing, Deploying and Customer Feedback

5.3.1 Testing

The PHP Unit Test was used in this project. Laravel 5.3 included a PHP Unit 5.0 with the best supports.

One of the biggest concerns of writing a test is that they it takes too much time to boot. Surely, one of the IDEs will launch a set of basic testing for developers, but writing manually a complete testing for code will take quite a long time. Just like in practice, investing time in doing the job in the right way can save developers a lot of time in their projects. Writing a reliable testing is one of those

cases. Furthermore, sometimes, developers do tests by accessing to the site and checking each page when new features are added. By running an available test, it can be much faster than to manually test all functions.

On the other hand, developers sometimes said that because of active applications, it was not necessary to write a test. They knew about the application, and they also knew how to fix a bug. Sometimes it took them just a few seconds. However, if junior developers fix bugs, seniors will realize why those tests are so important. Without the tests, fresh developers can change codes with no concerns and they will mess everything up. To avoid the appearance of bugs, tests should be repeated many times during the project. In any changes of codes or functions, tests will be run and this will guarantee that the older functions still work well.

The last reason that developers did not like to write tests is that they do not see the joy in doing that job. Developers just want to solve problems. As such, they consider that writing tests is boring, a job that they only do if there is free time. Thus, they ignored the value of tests, particularly in the application development process, to keep the process consistent and fluent. To fix bugs will waste a lot of time, and the test is just a small effort to avoid disappointment happening later.

However, developers should admit that writing a test is necessary especially in big projects with thousands of codes, and with tens of functionalities. Liikkuri was considered as a big project which will possibly be developed in the future so writing tests was very important at the beginning.

Unit Test is a technique used to test activities of details of code with a separate process from the process of developing. Thus, it helps to detect errors promptly. Unit testing can help to detect potential problems and errors in real time even before quality testing experts (QA - Quality Assurance) find them. It can even fix right from design ideas. (Bergmann 2017, cited 08.04.2017)

Unit Test is lines of codes structured like objects built to test in the application. Each Unit Test will send out a message and check the answer, include desired results and desired exception errors. (Bergmann 2017, cited 08.04.2017)

Unit Test operates continuously or periodically to explore and detect technical errors during the development process. Thus, Unit Test is also known as automated testing techniques. Unit Test plays a role as the first user of the system. (Bergmann 2017, cited 08.04.2017)

```php
<?php
use PHPUnit\Framework\TestCase;

class StackTest extends TestCase
{
    public function testPushAndPop()
    {
        $stack = [];
        $this->assertEquals(0, count($stack));

        array_push($stack, 'foo');
        $this->assertEquals('foo', $stack[count($stack)-1]);
        $this->assertEquals(1, count($stack));

        $this->assertEquals('foo', array_pop($stack));
        $this->assertEquals(0, count($stack));
    }
}
?>
```

FIGURE 21. Example of PHP Unit Test (Bergmann 2017, cited 08.04.2017)

Because of reasons mentioned above, Laravel integrated PHP Unit Test in its installment package. In this project, developers created many unit tests to check the flow of operations, performance and validation of inputs.

5.3.2 Deploying

After three months of processing, the projects was finished with basic features. The first version was released on 26 January 2017. The Helsinki garrison will try it first, then the other garrisons in the whole country will experience it in turn.

By collecting the user experience, the application will be improved and gradually become more popular in the future.

5.3.3 Customer Feedback

The Helsinki Garrison was the first unit which used the first release of the application.

At the beginning, they were quite impressed with the user interface, font, color and construction of buttons ordered reasonably. The Performance was considered good enough with around one thousand users. In the future, they will continue extend the scope of users to the other units and review more about its performance.

The List of notifications and tables was shown quite clear and as a good eye catcher in the desktop view and responsive in the mobile view. Enough Information was shown and it was clear and easy to read.

Authorization and Authentication were totally good. However, the colour of the notifications of errors needs to be changed. The red colour was not highlighted on the dark green background of the login form. Security was good with the validation system of prevent from special characters.

The Position of notification tables about upcoming events and reserved events should be discussed more. Conscripts use mobiles for the most of time thus, those tables should be in easy eye catching positions.

User experiences were quite good. Interactions with buttons were easy and convenient.

Finally, the application was suitable to original requirements and some features were exceeding the expectations, such as the reward system, booking event system and check in/ check out system.

6 CONCLUSION

This project was done in about four months. From the building of the foundation, planning, brain storming, and configuring the work environment to the first release, it took more than one month to the final report. It is a sufficient period for a small project but with the scope of this project, it will still be continued for long periods. It will be upgraded and improved in the near future when more and more units experience the application. However, the result was satisfactory with a junior developer. The company also appreciated the things a junior developer devoted to the project.

The problem of the previous web application was the lack of regular interaction of users and it was quite hard to operate on mobile devices. This application solved those problems. It was used daily and it is compatible with different devices. However, it faced challenges of maintaining. That is the reason the Finnish Defence Forces chose a responsible company, Finternet Group Oy, to finish this project. They did not want to suffer from the mistakes of the past and looked forward to a long-term support. The perspective of this application is expectable and it also gave me an opportunity for a persistent job.

During the period of working, there were many problems in designing and developing projects, such as the lack of experience in using VueJS, the Laravel framework and regularly created fat controllers. Also, JavaScript codes were quite messy. Working with experienced developers who have undergone several major projects helped me to get a proper direction of programming from the initial steps.

The greatest experience from this project is to avoid underestimating assigned tasks and customer's requirements. In addition, developers should always think about the future maintenance and plan to an appropriate direction. This might make the code base more complicated but it will be easier when there are some changes from customers and appearance of bugs.

From the experience gained through this project, I believe that my ability was tested. I am pretty fit to backend develop position and I am contemplating expectations for my career in the future. However, a full stack developer position is also a good direction and I am seriously thinking about it. I am very eager to experience more upcoming projects and face challenges to improve my skills to become a senior developer. Finally, I want to thank the support of the Finternet Group Oy. I also want to thank the colleagues in my company, who helped me to complete this project.

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